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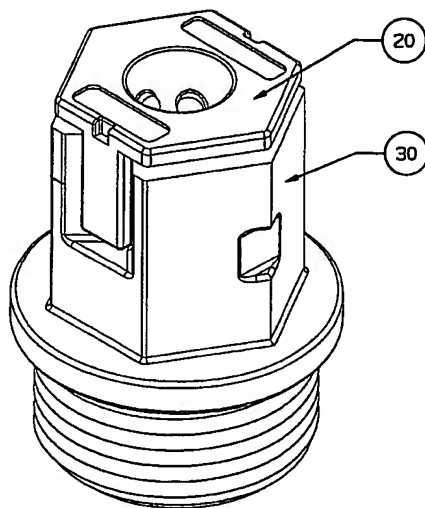
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(54) Title: SLIDING SCREW ARRANGEMENT



(57) Abstract: The present invention relates to a sliding screw arrangement (14) for transformation of the rotational movement of a threaded axis (13) into a linear movement of the sliding screw providing minimised tolerances for variations of the screw position in both radial and axial direction and providing minimised friction when moving the sliding screw arrangement along said threaded axis. The screw arrangement consists preferably of two parts (20, 30) and comprises a first resilient part, e.g. a spring (143), to compensate tolerances in axial direction and a second resilient part, e.g. a resilient tongue (25), and tracks (28) to compensate tolerances in radial direction. The screw hollowness through which the threaded axis is guided is at its inside is equipped with semi-spheres (21,31) that follow the turn of a thread of the axis.

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Sliding screw arrangement

FIELD OF THE INVENTION

The present invention relates to a sliding screw
5 arrangement, e.g., applicable in a tuner arrangement.

BACKGROUND OF THE INVENTION

Radio base filters for filtering and combining of a number
of sender units to one antenna cable are conventionally
10 built up of various units, e.g. a cavity, a resonator, and
one or more support units. The frequency range of such a
filter is mainly determined by the dielectric properties of
the resonator while the fine-adjustment of the filter
frequency is achieved by means of adjusting the position of
15 a tuner unit of an appropriate shape and consisting of a
dielectric material in relation to said resonator unit.
Commonly, this is achieved by means of inserting the tuner
to a certain degree into a hollowness of the resonator. The
tuning unit comprises, e.g., a ceramic tuner and a
20 fastening means, e.g. a screw nut, that is movably arranged
along a threaded axis in order to perform the movements of
the tuner relative to the resonator. The threaded axis is
driven by a motor unit whereby the screw nut transforms the
radial movement of the threaded axis into a linear movement
25 of the screw nut and the tuner.

For frequency tuning, e.g., in a radio base station, it is
crucial to achieve a high precision for such frequency
adjustments. This implies that the tolerances for undesired
variations of the tuner position must be as small as
30 possible. Preferably, a sliding screw or a similar
arrangement is used.

SUMMARY OF THE INVENTION

A problem of screw arrangements according to the state of the art, e.g. when fastening a tuner unit, is the
5 insufficient precision of position adjustments of the sliding screw along an axis of displacement.

It is thus an object of the present invention to achieve a sliding screw arrangement for transformation of the rotational movement of a threaded axis into a linear
10 movement of the sliding screw providing minimised tolerances for variations of the tuner position in both radial and axial direction.

It is another object of the present invention to achieve a minimised friction when moving the sliding screw arrangement
15 along the threaded axis.

These objects are achieved by means of the screw arrangement according to the present invention comprising a first resilient part, e.g. a spring, to compensate tolerances in axial direction and a second resilient part, e.g. a
20 resilient tongue, and tracks to compensate tolerances in radial direction. The screw arrangement comprises a hollowness through which the threaded axis is guided and which at its inside is equipped with semi-spheres that follow the turn of a thread of the axis.

25 It is a first advantage of the screw arrangement according to the present invention that it is possible to achieve high precision and low tolerances in both axial and radial direction.

It is another advantage of the present invention that the
30 screw arrangement provides a low degree of friction due to a

small area of touching and due to a lack of revolving details. No lubrication is necessary.

It is still another advantage of the present invention that the details of the screw arrangement can be manufactured in plastic, e.g. by means of casting, which reduces the electric losses and implies a lower weight.

When applied in a tuning arrangement it is thus an overall advantage of the present invention that a frequency tuning can be performed both faster and with a higher precision.

The invention will now be described in more detail by help of preferred embodiments and with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a sliding screw arrangement according to the present invention that is arranged on a threaded axis for axial movements of a tuner body. (InvDiscl Fig.4)

Figures 2a-2b show the first part of the screw arrangement according to the present invention in a perspective view and a cross section.

Figures 3a-3c show the second part of the screw arrangement according to the present invention in a perspective view, a cross section, and a view seen from above.

Figures 4a and 4b show the sliding screw arrangement according to the present invention comprising a first and a second part that are inserted into each other.

DETAILED DESCRIPTION

Figure 1 shows a tuning arrangement 10 including a screw arrangement 14 according to the present invention. The figure shows a cavity 12, e.g. applied for frequency tuning in a radio base station, within which a resonator 16 and a tuner 15 is arranged. Frequency adjustments are achieved by means of varying the vertical position of the tuner 15 in relation to the resonator 16. A motor unit 11 drives a threaded motor axis 13 on which the screw arrangement 14 according to the present invention is mounted. The screw arrangement 14 consists of a first screw part 141 and a second screw part 142 that are connected to each other and comprising a resilience, e.g. a spring 143, between them. This arrangement is responsible for converting the rotational movement of the motor axis 13 into a linear movement of the object, e.g. the tuner, that is fastened at the screw arrangement. In order to achieve a high precision for frequency adjustments, i.e. a high precision for variations of the tuner position, the screw arrangement 14 according to the present invention must provide both a low friction between the surfaces of the screw and the threaded axis and low tolerances in both axial and radial direction in response to the rotational movements of the motor axis 13. The arrangement 14 comprises at its one end fastening means, e.g. a threaded part, for fastening of the tuner 18.

The screw arrangement according to the present invention consists of two parts, which are shown in perspective views in figures 2a and 3a. Each of said parts 20,30 comprises a hollowness 22,32 through which the motor axis 13 of the cavity is protruded and which at its inside is equipped with one, preferably several, semi-spheres 21,31 that are arranged around the inside of said hollowness. The sliding properties of the screw can be influenced by the arrangement of said semi-spheres, their number and form. The semi-spheres are arranged to follow the threads of the axis 13 on

which the screw arrangement is mounted. Preferably, the semi-spheres follow one turn, or a multiple of turns, of the threaded axis 13. However, it is nevertheless a conceivable alternative that the semi-spheres are arranged to follow
5 only a part of one turn of the threaded axis or that there is only one single semi-sphere. For a preferred embodiment of the present invention it has turned out to be appropriate to apply at least three semi-spheres and, typically, six semi-spheres that follow one turn of the threaded axis and
10 secure by that means a sufficient steering of the screw part along said axis. As explained later in more detail, the first and second screw part are mounted together comprising a certain resilience between them, which causes a force that presses the semi-spheres to opposite parts of the threaded
15 axis. Therefore, the cross-section of the semi-spheres is preferably designed in such a way that there is a small touching surface between semi-spheres and threads in order to achieve a low friction while said touching surface at the same time must be sufficiently large to stand pressures when
20 moving the screw arrangement including, e.g. a tuner object, along the threaded axis. This can be achieved, e.g., by means of a spherical cross section as indicated in figures 2b and 3b. In order to minimise tolerances due to a bending of the first and second screw part when mounted together,
25 the sections of semi-spheres for each screw part are preferably separated from each other as far as possible.

The figures 2a-2c and 3a-3c relate to a screw arrangement consisting of two parts that can be inserted into each other. The first screw part 20, which is shown in figures 2a
30 and 2b, is built up of a screw hat 23 and, according to a preferred embodiment of the present invention, of a portion 24 having a cylindrical or another appropriate form. The screw hat 23 and the cylindrical portion comprises a diameter that is sufficiently large to allow said first
35 screw part to be screwed on a threaded axis along which the

screw arrangement shall be moved. In order to achieve a secure fastening of the first and second screw part and in order to eliminate the radial allowance of the screw arrangement the first screw part comprises at least one resilient tongue 25 that is fastened at the screw hat 23 and arranged in parallel to the cylindrical portion 24 such that there is a narrow slot 26 between said resilient tongue 25 and the cylindrical portion 24. The resilient tongue 24 is, according to a preferred embodiment of the present invention, at its end equipped with a bulge 27 that is directed towards the cylindrical portion 24. When the first and second screw part are mounted together, i.e. the cylindrical portion 24 is inserted into a corresponding opening of the second screw part 30, the outer edge 35 of the second screw part 30 can be inserted within said narrow slot 26. On that occasion the tongue 25 is guided along a track 36 of the second screw part 30 such that the bulge 27 can snap in a corresponding opening 37 of the second screw part 30 to provide a firm connection of both screw parts. The outside of the cylindrical portion 24 of the first screw part comprises one or more protrusions 28 that are arranged in a longitudinal direction along the cylindrical portion 24 in order to facilitate a correct mounting of the cylindrical portion of the first screw part into corresponding grooves 34 of the second screw part and in order to eliminate radial tolerances of said screw arrangement. This protrusions can have a spherical form or another appropriate form, e.g. a V-form.

The first and second screw part must be connected to each other in such a way that there is a certain resilience between them in order to eliminate the axial allowance. This resilience can be realised, e.g., by means of a resilient portion that is an integrated part of the first screw part where the lower part of the cylindrical portion 24 is designed as a spring. In another embodiment the resilience

is realised by means of a separate spring element 143 that is inserted within the hollowness 32 of the second screw part 30 such that its one end rests on a projection 33 within said hollowness while the other end lies on the lower edge of the cylindrical portion 24 of the first screw part 20. This spring element 143 is pressed together when the screw is mounted on the threaded motor axis 13 and exerts thus a force in a direction that presses the screw parts 20,30 away from each other. By that the semi-spheres 21,31 of each of the screw parts 20,30 are pressed to opposite sides of the threads of the threaded axis 13, which implies a secured position of the screw arrangement in axial direction that eliminates axial tolerances.

The first screw part 20 according to the preferred embodiment of the present invention, as shown in figure 2a and 2b, is designed to be inserted into the second screw part 30. Another conceivable design could be a first screw part 20 that only consists of a screw hat 23 or comprising a cylindrical portion 24 of significantly reduced length. Such an embodiment comprises preferably more than one resilient tongue 25 as the first and second screw parts are connected to each other only by help of said tongues in a way as described above.

The second screw part 30, which is shown in figures 3a-3c, comprises a hollowness 32 having a diameter that corresponds to the diameter of the cylindrical portion 24 of the first screw part 20 when assuming an embodiment where the first screw part 20 is inserted into the second screw part 30. If said first screw part 20 is equipped with protrusions 28 along its cylindrical portion 24 as described above the second screw part 30 must comprise grooves 34 of a corresponding form such that said protrusions 28 can be guided on said grooves 34 and thus allow a secure mounting of the screw parts 20,30 and prevent radial allowance. The second screw part 30 comprises at its one end a fastening

means, preferably a screw threading, to fasten an object, e.g. a tuner, that shall be moved along the threaded axis 13.

5 An appropriate material for the screw arrangement according to the present invention is selected with respect to its electrical and mechanical properties. The material must comprise low electric losses when the screw arrangement is located, e.g., inside the tuner cavity, which implies that the screw can influence the electromagnetic field within the 10 cavity. Regarding the mechanical properties, the screw must consist of a material having a low friction and a good sliding surface. An example of a conceivable material comprising low electric losses is polyeterimid, preferably comprising a certain concentration of teflon. Another 15 material, which is conceivable for less demands on electric losses, is acetalplastics with a certain concentration of teflon.

The invention is not restricted to the embodiments that have been described above and have been shown in the drawings but 20 can be modified within the scope of the accompanying claims.

CLAIMS

1. A screw arrangement (14) comprising a hollowness (22,32) for insertion of a threaded axis (13) along which the screw arrangement (14) is movably arranged,
- 5 c h a r a c t e r i s e d i n
- a first resilient part (143) to eliminate an axial allowance and a second resilient part (25) to eliminate a radial allowance,
- the screw hollowness (22,32) at its inside being equipped
- 10 with semi-spheres (21,31) that follow the turn of the threads of the threaded axis (13).
2. The screw arrangement according to claim 1, whereby the screw consists of a first part (20) and a second part (30) that are connectable to each other.
- 15 3. The screw arrangement according to claim 2, whereby the first part (20) can be inserted into the second part (30).
4. The screw arrangement according to claim 2 or 3, whereby the first resilient part constitutes a separate spring (143).
- 20 5. The screw arrangement according to claim 2 or 3, whereby the first resilient part constitutes an integrated part of the first part of the screw.
6. The screw arrangement according to claim 4 or 5, whereby the second resilient part constitutes at least one resilient
- 25 tongue (25) that is arranged in parallel to the screw axis for insertion into corresponding grooves (35) of the second screw part (30).
7. The screw arrangement according to claim 6, whereby the resilient tongue (25) at its end is equipped with a bulge

(27) to secure a firm connection of the first and second screw part.

8. The screw arrangement according to claim 3, whereby the first screw part (20) comprises one or more convex protrusions (28) and the second screw part (30) comprises corresponding grooves (34) for insertion of the first part into the second part.

9. The screw arrangement according to claim 1, whereby six semi-spheres (21,31) are arranged at the inside of the screw hollowness (22,32) of the first and second screw part which follow one turn of the threaded axis (13).

10. The screw arrangement according to claim 1, whereby the semi-spheres (21,31) comprise a cross section that minimises the contacting surface between semi-sphere and the threaded surface of the axis.

11. The screw arrangement according to one of the preceding claims comprising a threaded means for fastening of a tuner object.

12. The screw arrangement according to one of the preceding claims consisting of a plastic material that comprises a sliding surface and low electric losses.

13. A tuning arrangement (10) for precision steering of the position of a tuner (15) in a cavity (12),

c h a r a c t e r i s e d i n

25 the tuner (15) being movably arranged at a threaded axis (13) by help of a screw arrangement (14) according to one of claims 1-12.

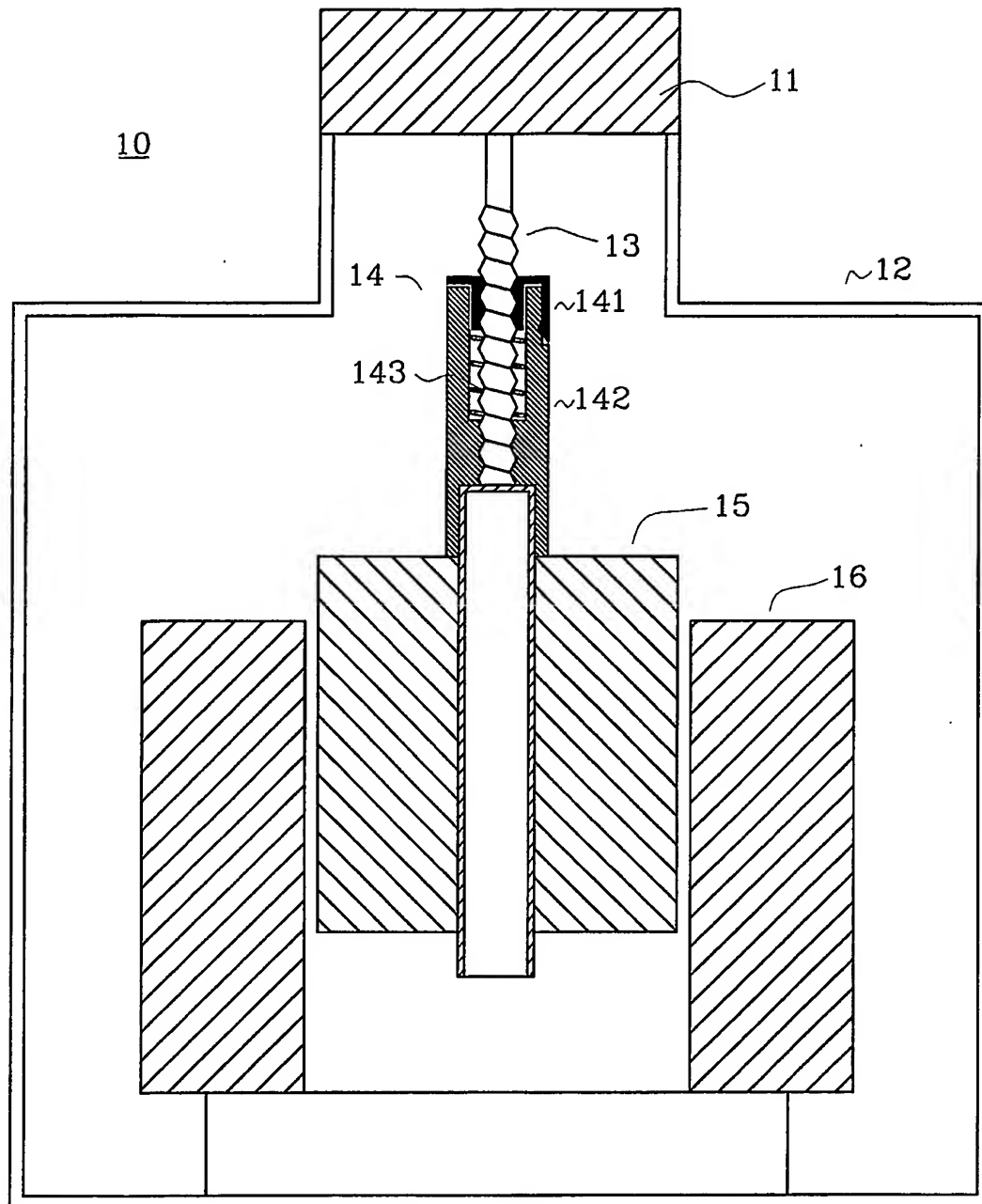


Fig. 1

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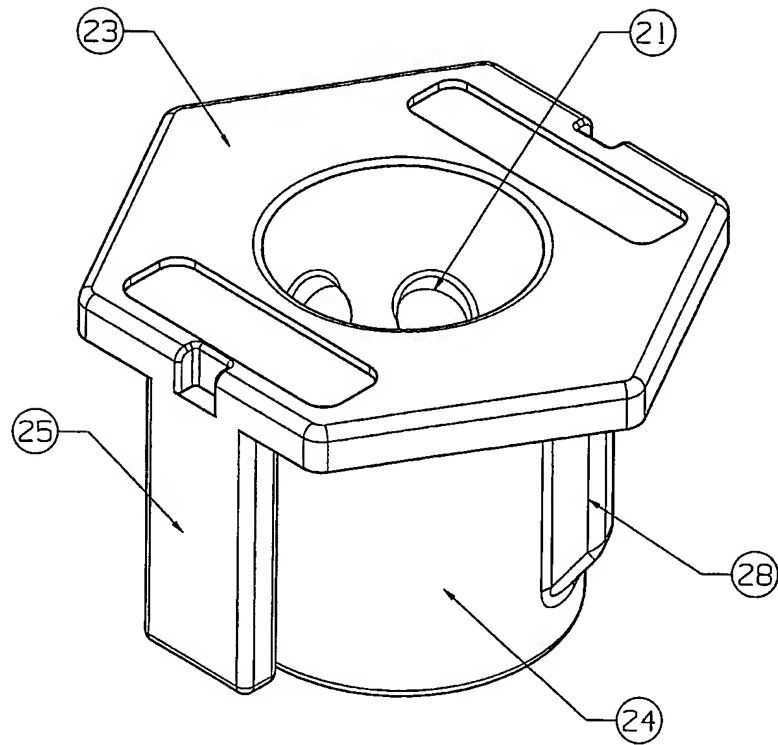


Fig. 2a

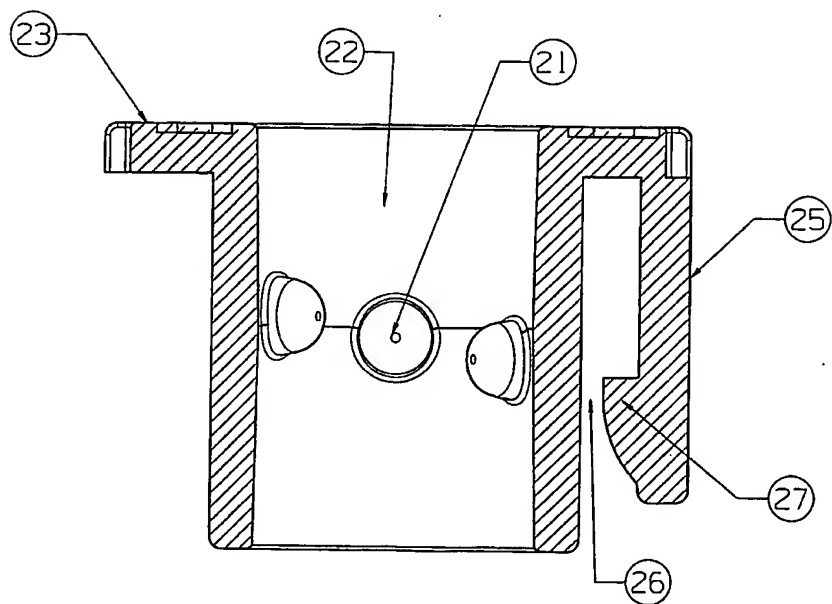


Fig. 2b

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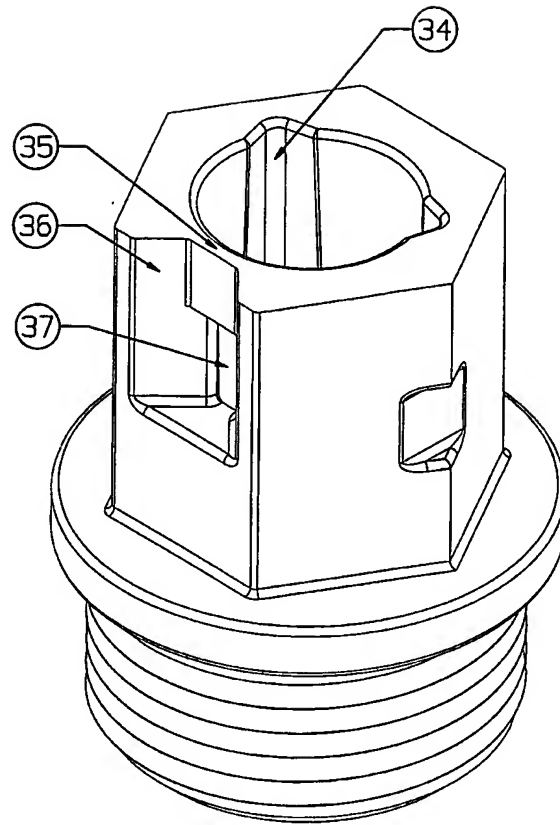


Fig. 3a

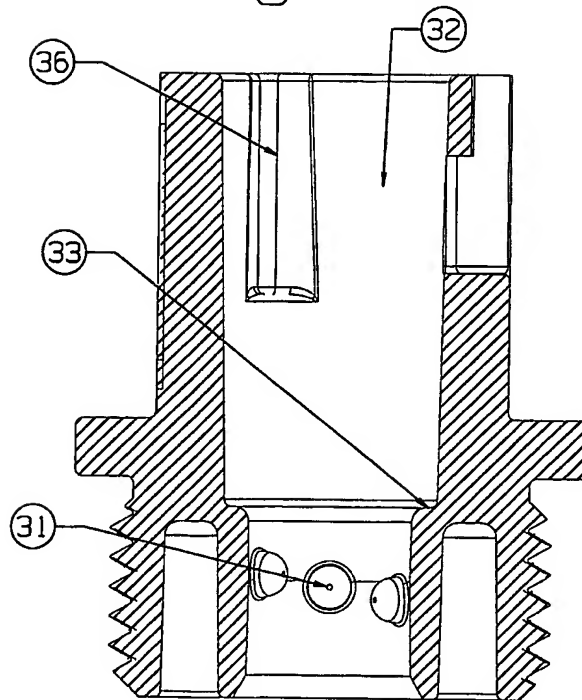


Fig. 3b

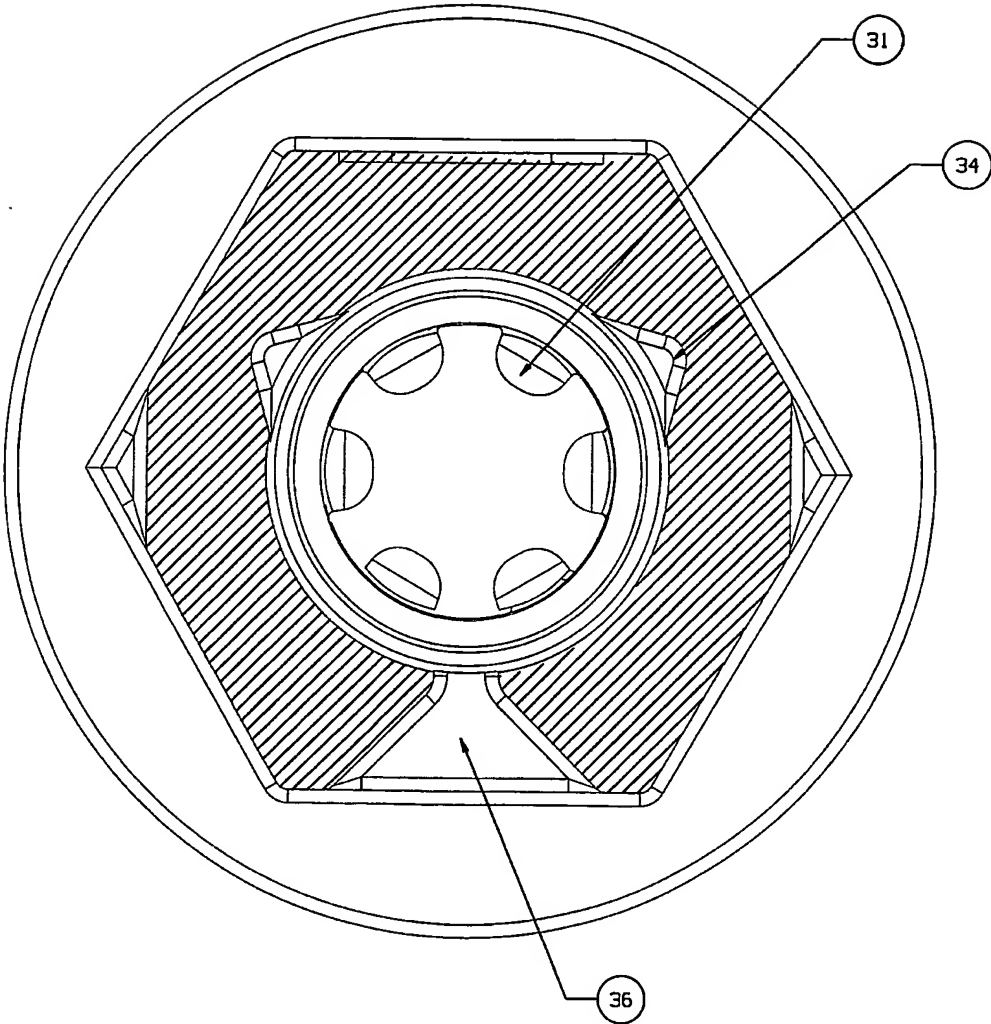


Fig. 3c

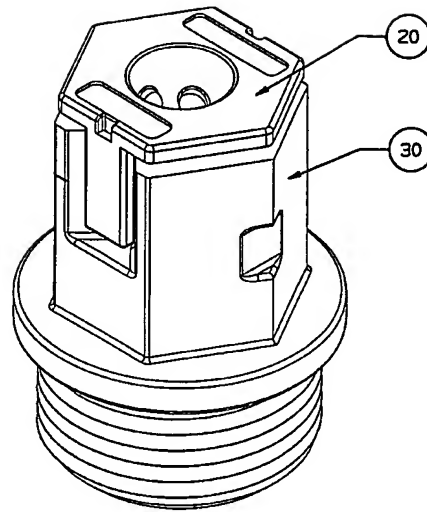


Fig. 4a

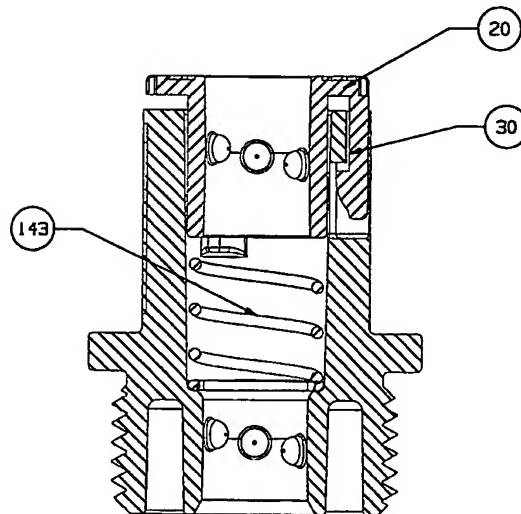


Fig. 4b

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 03/00076

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H03J 1/14, H01P 1/207

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H01P, H03J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication; where appropriate, of the relevant passages	Relevant to claim No.
A	US 2002150335 A1 (RICHARD L. LACHANCE ET AL), 17 October 2002 (17.10.02), see the whole document --	1-13
A	US 5039966 A (HARTMUT SCHMID ET AL), 13 August 1991 (13.08.91), see the whole document --	1-13
A	GB 1520420 A (EMI-VARIAN LIMITED), 9 August 1978 (09.08.78), see the whole document -- -----	1-13

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/06/03

International application No.

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Patent document cited in search report			Publication date	Patent family member(s)	Publication date
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GB	1520420	A	09/08/78	NONE	
